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RESEARCH ARTICLE

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GUSTATORY FUNCTION OF ELDERLY WOMEN: FREQUENCY OF HYPOGEUSIA AND ASSOCIATED FACTORS

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ABSTRACT

Objective: To identify the gustatory function of the four basic tastes of elderly women, frequency of hypogeusia and associated factors. **Methodology:** Cross-sectional study with elderly women from a coexistence group in southern Brazil. Sociodemographic variables, life habits and health were analyzed. In order to evaluate the gustatory function, filter-paper "taste strips" were soaked in solutions of four different concentrations of the sweet, salty, bitter and acidic flavors and the correct answers were evaluated, ranging from 0 to 16. Hypogeusia was characterized by the correct identification of up to eight right answers. **Results:** Sixty-four elderly women with a mean age of 69.8 ± 7.3 years participated in the study. The mean of the total score in the gustatory evaluation was 11.9 ± 2 hits and 14.1% of the evaluated women presented hypogeusia. Sweet and bitter flavors had higher mean values of right answers and acid (<0.001) and salty flavors (<0.001) had higher statistical differences in the group with and without hypogeusia. This condition was not statistically associated with sociodemographic data, style, quality of life and nutritional status. **Conclusion:** There was a low prevalence of hypogeusia in the sample and this condition was not statistically associated with the analyzed variables. The salty and acidic flavors were the ones that demonstrated the greatest differences for detection and adjustment between individuals with and without hypogeusia.

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INTRODUCTION

Physiological changes that constitute the aging process are complex and depend on factors such as lifestyle and environmental conditions (Freitas and Py, 2011; WHO, 2015). Some changes of the aging process are the sensory changes, such as reduction of sensitivity for primary tastes (Narukawa et al., 2017). Several studies related to changes of taste in aging have shown reduced perception of taste (Mojet et al., 2001; Mojet, 2005; Fukunaga et al., 2005; Simpson et al., 2012). Several factors may be associated with this loss, such as physiological changes, use of multiple medicines, nutritional deficiency, comorbidities, life condition, such as smoking and alcohol consumption, poor oral hygiene, dental prostheses, general health and sociocultural status (Nogués 1995; Imoscopi et al., 2012; Solemdal et al., 2012; Ogawa et al., 2016). The deficiency of the gustatory perception related to age, despite not being clearly elucidated, represents a determinant of reduction of pleasure related to food, and may increase the risk of foodborne diseases, reduced food consumption and change of food choices (Imoscopi et al., 2012; Murphy, 2008). Changes of taste can be classified into three diagnostic categories: ageusia (total loss of taste), hypogeusia

(reduced ability to taste) or disgeusia (distortion of taste). The amendment of taste can occur throughout life, and the prevalence of hypogeusia and disgeusia increases significantly for elders (Schiffman, 2009; Fark et al., 2013). One way to assess the loss of sensitivity to basic flavors are tests that measure the ability to perceive, identify and/or differentiate one or more stimuli by the organs of the senses. The detection threshold is understood as the lowest concentration of certain solute, capable of producing a sensation, in which increasing or decreasing series of concentrations are offered to the taster until the last answer (detection/not detection) occurs (Piovesana et al., 2012). Therefore, it is important to conduct studies that assess the factors that can affect the taste, in particular in the population over 60 years old, once its change can relate to their quality of life, health and food choices (Atzingen and Silva, 2010; Simpson et al., 2012). In this way, this work aimed to identify the gustatory function of the four basic flavors of elderly women, frequency of hypogeusia and relate this condition to socio demographic data, life habits and health.

MATERIALS AND METHODS

Cross-sectional study with 64 elderly women from a coexistence group in the southern region of Brazil. The study included women aged 60 years or more, participating in a coexistence group in South Brazil, who were apt according to the cognitive assessment of the Mini Mental State Examination (MMSE) (Bertolucci *et al.*, 1994). The research excluded women with self-reported lesions and/or injuries and/or bleedings in the oral cavity, under chemotherapy and/or radiotherapy and/or hospitalization in the data collection period. The coexistence group consisted of 102 elderly women eligible according to the inclusion criteria, with the exclusion of eight elderly women (two for not achieving the required MMSE score and six for incomplete filling of the form). However, 64 participants were present on the data collection day, with this as the number of participants in this study, representing 62.74% of the coexistence group. The assessed sociodemographic data were: age, marital status, education, family income and arrangement. Life and health habits were: number of diseases, number of self-reported continuous use medications prescribed by a physician, current smoking, use of dental prosthesis, difficulty feeling the taste of the food, habit of hygiene of the tongue, Body Mass Index (BMI) and quality of nutrition. The BMI was calculated by dividing the body weight by the squared height, and the results were expressed in kg/m². The weight was measured with portable digital balance Plenna® previously calibrated and with light clothing. The height was measured with a metric tape attached to the wall without footnotes, with the participant with her feet together and barefoot and with heels, buttocks and shoulders touching the wall. The cut-off points for elderly people used to classify the BMI followed the recommendation of the Pan American Health Organization (Organização Pan-Americana de Saúde, 2003): low weight (BMI < 23 kg/m²), normal weight (BMI > 23 and < 28kg/m²), pre-obesity (BMI ≥ 28 and < 30kg/m²) and obesity (BMI ≥ 30 kg/m²).

The gustatory function of the four basic tastes (sweet, salty, acidic and bitter) were determined using the methodology proposed by Mueller *et al.* (2003), based on the "taste strips. The strips were previously manufactured, following the model proposed by Kettenmann *et al.* (2005), made of paper filter (Blue Ribbon® 90.0±1.0 mm; 0,00005g), with 8 cm in length and 2 cm² area at the tip. The strips were soaked in solutions with different concentrations of salt, sweet, bitter and sour and distilled water as shown in Table 1. Each participant received 18 strips, since each flavor was presented in four different concentrations (four flavors x four concentrations) and two others with no taste. The concentrations followed an order from one through four, considering number 1 as the highest concentration and number 4 as the lowest concentration of each of the four flavors. The taste strips were offered from the highest to the lowest concentration. The concentrations of the solutions were prepared in compounding pharmacy and subsequently placed in closed and dark bottles, kept in a cool environment and without light and at environmental temperature. The volunteers kept the strips on their tongue during 10 seconds with the mouth shut, on the dorsal surface of the tongue with movement guidance until the possible identification of flavor, assigning one point for each strip correctly identified, resulting in a final score for subsequent classification. The highest score of the test is 16 points (the strips with no taste does not score). The classification of hypogeusia used a percentile equal to or below 100 (identification of up to 8 flavors) (Doty *et al.*, 1994; Kobal, 2001). The data were analyzed using the Stata 12.0. Quantitative data were summarized using mean and standard deviation and categorical variables were described as frequencies and percentages. The groups were compared using Student's t test and chi-square test. In order to assess the associations between individual characteristics and the outcome, Poisson regression models were constructed. Differences were considered statistically significant for values of p<0.05. The Ethics Committee of the Federal University of Santa Maria approved the research and all participants consented their participation by signing the informed consent form.

RESULTS

Sixty-four elderly women, with an average age of 69.8±7.3 years, participated in the survey. Half of the individuals (50%) had family income between 1.9 to 5.7 Minimum Wages (MW), schooling equal to or greater than 5 years (81.2%) and shared their residence with someone (75%). In relation to health and quality of life, most elderly women have two or fewer diseases (78.1%) and use up to 3 medicines/day (76.3%) and a small portion of the sample currently smokes (6.2%). In relation to oral health, there was a high prevalence of use of dental prostheses (85.9%) and 15.9% reported having difficulty feeling the taste of the food. The habit to sanitize the tongue was reported by 81.3% of the elderly. Regarding the classification of the BMI, there was a predominance of overweight/obesity (56.2%); regarding the evaluation of the quality of the food, the majority features as satisfactory (65.6%) (Table 1). The taste scores of the four basic flavors ranged from five to 16 right answers, with an average of 11.9±2.7 right answers. In the sample, 14.1% (n=9) of the assessed elderly women had hypogeusia. The highest percentage of correct answers among the four basic flavors was the salty flavor (89.6%) and the lowest was the taste acid (62.5%) (Table 2). Table 3 shows the proportion of correct responses for each of the 16 flavors tested by participants with and without hypogeusia. For sweet flavors, all participants correctly identified solution 1, the most concentrated, regardless of whether having been classified with or without hypogeusia. For concentrations 2 and 3 of the sweet taste, the frequency of flavors properly identified (77.8% and 66.7%, respectively) was statistically lower for individuals with hypogeusia (p=0.007 and p=0.041). There was no statistically significant difference between the two groups for the correct detection of sweet flavor in concentration 4 (p=0.281). In relation to the bitter flavor, the elders without hypogeusia showed higher frequencies of correct answers in concentrations 1, 3 and 4 (p=0.002, p=0.010 and p=0.038, respectively). In Table 3, the analysis compared the difference between the proportions of individuals (with and without hypogeusia) who felt the flavors tested in different concentrations. In addition, for an overview of each flavor, we considered the number of hits (regardless of concentrations) in the group that presented hypogeusia and the group that did not present this condition. This provides an overview of how individuals in the sample, depending on their condition, are able to perceive each of the flavors tested. The salty and acid flavors were those that showed the greatest differences for detection and accuracy between individuals with and without hypogeusia. The frequencies of correct responses between individuals without hypogeusia were statistically higher for all concentrations of salty flavor (p=0.006, p=0.001, p=<0.001, p=0.020), respectively in accordance with concentrations 1, 2, 3 and 4. The individuals classified with hypogeusia obtained the lowest frequencies of right answers for the salty taste in concentrations 1 and 4, both with 33.3%. No participant with hypogeusia correctly identified concentration 3 of the salty taste, while 85.4% of those classified without hypogeusia identified the flavor correctly. For all concentrations of acid flavor, individuals without hypogeusia presented statistically higher frequencies of right answers in concentrations 1, 2, 3 and 4 (p=0.003, p=0.007, p=0.001 and p=0.007, respectively). Elderly women with hypogeusia presented smaller average scores for all flavors, whereas the sweet (2.78±0.67) and bitter (2.22±1.09) flavors had the highest averages of correct responses (Table 3). Although individuals in disadvantaged socioeconomic conditions tended to have greater probability of presenting hypogeusia, these associations were not statistically significant (Table 4).

DISCUSSION

With the objective of identifying the gustatory function of active elderly women, the frequency of hypogeusia and associated factors, the study innovates once it assesses the presence of hypogeusia through taste scores of the four basic flavors and associates this condition with lifestyle, quality of life and BMI.

Frame 1. Concentrations used in the solutions of the four basic tastes

Taste/componente	Concentrations (g/ml)*			
	(1)	(2)	(3)	(4)
Sweet/sucrose	0.4	0.2	0.1	0.05
Bitter/quinine sulfate	0.006	0.0024	0.0009	0.0004
Salted/sodium chloride	0.25	0.1	0.04	0.016
Acid/citric acid	0.3	0.165	0.09	0.05

*Descending order Source: MUELLER *et al.* (2003).

Table 1. Sociodemographic characteristics, life and health habits of the elderly women (n= 64)

Variables	n	%
Family income (MW)*		
≤ 1.9	21	32.8
> 1.9 to 5.7	32	50.0
> 5.7	11	17.2
Schooling (years of study)		
≥ 5	52	81.2
< 5	12	18.8
Family arrangement		
Living alone	16	25.0
Living with someone	48	75.0
N. Diseases		
≤ 2	50	78.1
> 2	14	21.9
N. Medications		
≤ 3	49	76.6
> 3	15	23.4
Satisfaction with the quality of life		
Very bad / Bad	3	4.7
Regular	7	10.9
Very good / Good	54	84.4
Satisfaction with the health		
Very bad / Bad	14	21.9
Regular	15	23.4
Very good / Good	35	54.7
Currently smoking		
Yes	4	6.2
No	60	93.8
Use of prosthesis		
Yes	55	85.9
No	9	14.1
Difficulty feeling the taste of food		
Yes	10	15.9
No	54	84.1
Tongue hygiene habit		
Yes	52	81.3
No	12	18.7
Body Mass Index (BMI)		
Low weight	12	18.8
Normal weight	16	25
Overweight / Obesity	36	56.2
Quality of nutrition		
Unsatisfactory	1	1.6
Satisfactory	42	65.6
Great	21	32.8

*MW: Minimum Wage (Brazilian MW value in November 2015 = R\$788 or its corresponding at that time, roughly US\$203).

The interest in the changes related to sensory aspects of foods can be explained by the constant increase in the elderly population worldwide, requiring elucidation of the possible dysfunctions of taste, once it may cause a reduction in appetite, leading to an inadequate food intake (Mojet *et al.*, 2001; Ogawa *et al.*, 2016). The loss of taste in function of age occurs gradually and many elderly people are not aware of the abnormality of perception of flavor (Satoh-Kuriwada, 2009). The present study found a gustatory function in elders characterized by greater recognition of sweet and bitter flavors. The prevalence of hypogeusia in the sample was 14.1% and did not find associations between associated factors and presence of hypogeusia. Hypogeusia seems to be more related to the aging process and is present in about 5% of the population in general (Welge-Lüssen, 2011; Bhattacharyya, 2015). However, there is little knowledge on the prevalence of hypogeusia in the active elderly population in Brazil and neither our results can be extrapolated to the national population.

The presence of hypogeusia in this study was greater than that found with adults and smaller than a study conducted with elderly Brazilians from the same life condition (Lopes *et al.*, 2016). The evaluation of taste in the present study occurred through the taste strips method, since it is a validated test, fast, convenient, long useful life and easily transportable, in addition to identifying taste score and percentile for hypogeusia (Doty *et al.*, 1994; Landis *et al.*, 2009). The research of Landis *et al.* (2009) showed a total average score of correct responses in elderly individuals of both sexes of 9.75 and confirmed that the taste decreases with age, and there were no statistical differences in the right and left sides of tongue. The results of this study are superior to the average taste scores of the Portuguese adult population, which was 9.4±4.7 right answers and smaller than of the German population 12.4±2.3 (Ribeiro *et al.*, 2016). In the study by Lopes *et al.* (2016), among elderly Brazilians, a higher percentage of correct responses of the taste test was of bitter (86.2%) and acid (85.7%) flavors, whereas the lowest was the sweet (59.6%) and salt (58.6%) flavors.

Table 2. Distribution of the taste score according to the percentile, total of right answers of the four flavors and percentage of hypogeusia of the sample (n= 64)

Percentile	N. of right answers	Total of right answers of the four basic flavors	%	Hypogeusia	n (%)
10 th	8	Sweet	81.2	Presence	9 (14.1)
25 th	10	Bitter	70.3	Absence	55 (85.9)
50 th	13	Salty	89.6		
75 th	14	Acidic	62.5		
90 th	15				

Taste Score: Number of flavors correctly identified SD=Standard Deviation

Table 3. Distribution of the frequency of right answers for each taste concentration according to the presence or absence of hypogeusia (n=64)

Flavor	Concentration	Hypogeusia		p-Value
		Yes (n=9) n (%)	No (n=55) n (%)	
Sweet	1	9 (100)	55 (100)	-
	2	7 (77.8)	54 (98.2)	0.007*
	3	6 (66.7)	50 (90.9)	0.041*
	4	3 (33.3)	29 (52.7)	0.281*
Mean±SD of right answers/person		2.78±0.67	3.40±0.68	0.025**
Bitter	1	5 (55.6)	51 (92.7)	0.002*
	2	7 (77.8)	50 (90.9)	0.242*
	3	5 (55.6)	49 (89.1)	0.010*
	4	3 (33.3)	38 (69.1)	0.038*
Mean±SD of right answers/person		2.22±1.09	3.45±0.83	0.009**
Salty	1	3 (33.3)	43 (78.2)	0.006*
	2	2 (22.2)	42 (76.4)	0.001*
	3	0	47 (85.4)	<0.001*
	4	3 (33.3)	40 (72.7)	0.020*
Mean±SD of right answers/person		0.89±0.78	3.12±1.19	<0.001**
Acidic	1	1 (11.1)	35 (63.6)	0.003*
	2	2 (22.2)	38 (69.1)	0.007*
	3	2 (22.2)	42 (76.4)	0.001*
	4	2 (22.2)	38 (69.1)	0.007*
Mean±SD of right answers/person		0.78±0.44	2.78±1.18	<0.001**

* Chi-square Test ** t-Student Test Although individuals in disadvantaged socioeconomic conditions tended to have greater probability of presenting hypogeusia, these associations were not statistically significant (Table 4)

Table 4. Analysis of individual characteristics associated with hypogeusia through Poisson Regression models Santa Maria, RS, Brazil (n=64 individuals)

Characteristics	Hypogeusia		
	PR*	CI**(95%)	p-Value
Age			
≤ 79 years	1		-
≥ 80 years	1.74	0.36-8.40	0.487
Income			
> 3 MW***	1		-
≤ 3 MW	1.96	0.41-9.45	0.400
Schooling (years of study)			
≥ 5	1		-
<5	2.16	0.54-8.66	0.274
N. diseases			
≤ 2	1		-
> 2	1.78	0.45-7.14	0.412
N. medications			
≤ 3	1		-
>3	1.63	0.41-6.53	0.488
Tongue hygiene			
Yes	1		-
No	1.20	0.63-2.29	0.561
Satisfaction with the health			
Good/Very good	1		-
Bad/Very bad	1.03	0.28-3.86	0.957
Use of Dental Prosthesis			
No	1		-
Yes	0.84	0.41-1.71	0.624
Body Mass Index			
Normal weight	1		-
Overweight/Obesity	0.62	0.17-2.31	0.479
Quality of nutrition			
Unsatisfactory	1		-
Satisfactory/great	0.58	0.12-2.82	0.504

*PR: Prevalence Ratio **CI: Confidence interval ***MW: Minimum Wage (Brazilian MW value in November 2015 = R\$788 or its corresponding at that time, roughly US\$203).

Toffanello *et al.* (2013) found that advanced age and polypharmacy were positively related to a reduced bitter taste. The chronic use of medications alters the taste, but the way it occurs is not completely elucidated, but variations occur at any age and is more prevalent in elderly people (Toffanello *et al.*, 2013). Although there was no significant relationship between hypogeusia and body mass index in elderly patients, we believe that this was an innovative purpose of our study, since other jobs analyzed only changes of taste in this population with chronic use of medications and with associated diseases (Douglass and Heckman, 2010; Ponticelli *et al.*, 2017). Smoking, alcohol consumption and compromised oral hygiene also contribute to change of taste and must be addressed as preventive health measures (Douglass and Heckman, 2010). Studies have reported a higher limit for detecting bitter taste among smokers, whereas others have reported that smoking tends to raise the threshold of recognition of all four basic flavors (Vellappally, 2007). This study did not find relation between hypogeusia and habit of tongue hygiene and smoking. Simpson *et al.* (2012) evaluated the perception of taste of elderly people with different European nationalities, concluding that the main predictors of acuteness of the four basic flavors were age, social class and country. In the present study, there was no statistical difference in elderly women with hypogeusia regarding income and schooling, probably because the sample was small and very homogeneous regarding socioeconomic variables. Therefore, the effect of age on sensory perception and, specifically, on taste is complex, due to the great heterogeneity among the elderly population, in addition to varied extent and definition of this decline between the taste and artificial modalities, and between the researches (Methven, 2012). Further investigations are necessary to understand the different sensory abilities among elderly people in the community in general, institutionalized, hospitalized in both sexes, once the sample does not represent the profile of the Brazilian geriatric population. Findings about this topic can better understand which factors involved in aging can interfere in taste.

CONCLUSION

There was a moderate percentage of hypogeusia in the sample and this condition was not statistically associated with sociodemographic data, style, quality of life and BMI. The gustatory function of elderly women was characterized by a higher percentage of correct responses in the identification of the sweet flavor and the lowest identification was the acidic taste. The salty and acidic flavors showed the greatest differences for detection and accuracy between individuals with and without hypogeusia.

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